

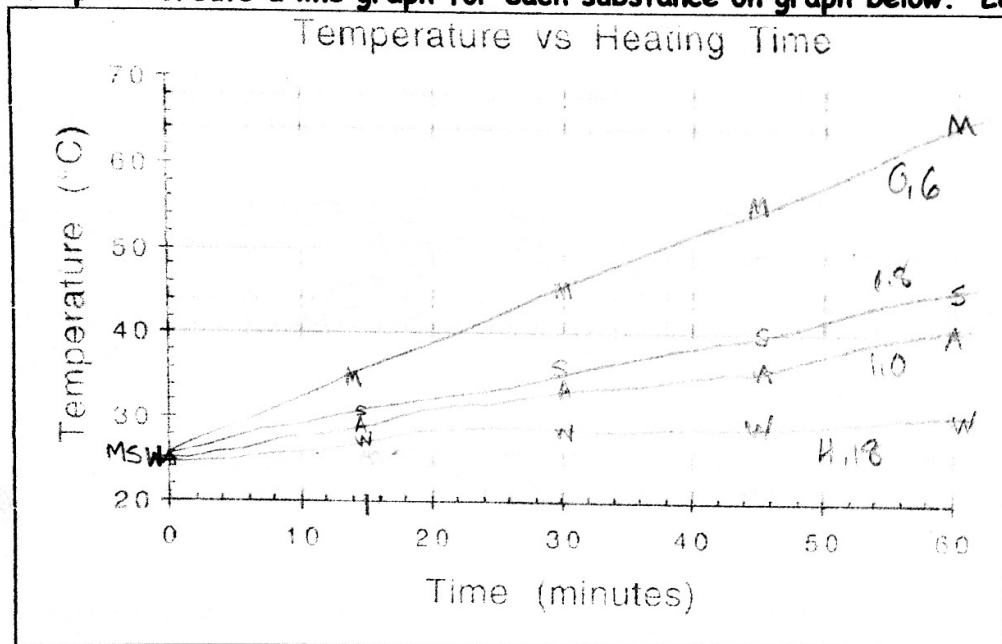
## Worksheet- Introduction to Specific Heat Capacities

Heating substances in the sun: The following table shows the temperature after 10.0 g of 4 different substances have been in direct sunlight for up to 60 minutes.

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Time (minutes)	Air ( $^{\circ}\text{C}$ )	Water ( $^{\circ}\text{C}$ )	Sand ( $^{\circ}\text{C}$ )	Metal ( $^{\circ}\text{C}$ )
0 (initial)	25 $^{\circ}\text{C}$	25 $^{\circ}\text{C}$	25 $^{\circ}\text{C}$	25 $^{\circ}\text{C}$
15.0 min	28.9 $^{\circ}\text{C}$	26.2 $^{\circ}\text{C}$	30 $^{\circ}\text{C}$	35 $^{\circ}\text{C}$
30.0 min	32.5 $^{\circ}\text{C}$	27.5 $^{\circ}\text{C}$	35 $^{\circ}\text{C}$	45 $^{\circ}\text{C}$
45.0 min	36.2 $^{\circ}\text{C}$	28.8 $^{\circ}\text{C}$	40 $^{\circ}\text{C}$	55 $^{\circ}\text{C}$
60.0 min	40 $^{\circ}\text{C}$	30 $^{\circ}\text{C}$	45 $^{\circ}\text{C}$	65 $^{\circ}\text{C}$

Step 1: Create a line graph for each substance on graph below. Label the substances.



### Step 2: Answer questions

1. Order the substances based on the time required to heat them from:

slowest water  
air  
sand  
fastest metal

2. Which do you think will cool the fastest? Explain

metal

3. When you boil water in a pot on the stove, which heats faster, the metal or the water? Explain.

metal  $\rightarrow$  temp of metal increased more in the same amount of time

4. Why do you think different substances heat up and cool down at different rates?

- material property  $\rightarrow$  different heat capacities

\*\*\*Specific heat capacity = the amount of heat needed to raise the temperature of 1 g of a substance by 1 degree. \*\*\*

5. Based on the definition above, which of the 4 substances do you think has:

a) the highest specific heat capacity?

water

b) the lowest heat capacity?

metal

6. Here are the heat capacities of the four substances: 4.18 J/g  $^{\circ}\text{C}$ , 1.00 J/g  $^{\circ}\text{C}$ , 0.80 J/g  $^{\circ}\text{C}$ , & 0.60 J/g  $^{\circ}\text{C}$ . Match & then label each substance with its specific heat capacity on the graph.

7. If something has a high specific heat capacity will it take a lot of heat or a little heat to change its temperature? Explain. (careful! Use the definition, your graph, and the data from #6)

It will take a lot of heat. High heat capacity = more heat required to increase temp  $1^{\circ}\text{C}$

8. Assuming they both start at the same temperature, which will heat up faster, a swimming pool or a bath tub? Explain your thinking.

Bath tub

- swimming pool has more mass & requires more energy

## WORKSHEET - CALCULATIONS INVOLVING SPECIFIC HEAT

1. For  $q = m \cdot c \cdot \Delta T$ : identify each variables by name & the units associated with it.
2. Heat is not the same as temperature, yet they are related. Explain how they differ from each other.

a. Perform calculations using:  $(q = m \cdot c \cdot \Delta T)$

1. Gold has a specific heat of  $0.129 \text{ J/(g}^\circ\text{C)}$ . How many joules of heat energy are required to raise the temperature of 15 grams of gold from  $22^\circ\text{C}$  to  $85^\circ\text{C}$ ?

$$Q = 120 \text{ J}$$

Endothermic or exothermic? endo

3. If the temperature of 34.4 g of ethanol increases from  $25^\circ\text{C}$  to  $78.8^\circ\text{C}$ , how much heat has been absorbed by the ethanol? The specific heat of ethanol is  $2.44 \text{ J/(g}^\circ\text{C)}$

$$Q = 4500 \text{ J}$$

Endothermic or exothermic? endo

5. Copper has a specific heat of  $0.385 \text{ J/(g}^\circ\text{C)}$ . A piece of copper absorbs 5000 J of energy and undergoes a temperature change from  $100^\circ\text{C}$  to  $200^\circ\text{C}$ . What is the mass of the piece of copper?

$$m = 129.87 \text{ g}$$

Endothermic or exothermic? endo

7. A 40 g sample of water absorbs 500 Joules of energy. How much did the water temperature change? The specific heat of water (liquid) is  $4.18 \text{ J/(g}^\circ\text{C)}$ .

$$\Delta T = 3^\circ\text{C}$$

Endothermic or exothermic? endo

b. Determine if it's endothermic or exothermic

2. An unknown substance with a mass of 100 grams absorbs 1000 J while undergoing a temperature increase of  $15^\circ\text{C}$ . What is the specific heat of the substance?

$$c = 0.7 \text{ J/g}^\circ\text{C}$$

Endothermic or exothermic? endo

4. Graphite has a specific heat of  $0.709 \text{ J/(g}^\circ\text{C)}$ . If a 25 gram piece of graphite is cooled from  $35^\circ\text{C}$  to  $18^\circ\text{C}$ , how much energy was lost by the graphite?

$$Q = -300 \text{ J}$$

Endothermic or exothermic? exo

6. 45 grams of an unknown substance undergoes a temperature increase of  $38^\circ\text{C}$  after absorbing 4172.4 Joules. What is the specific heat of the substance? ~~look at the table on page 513 of your book, and identify the substance.~~

$$c = 2.4 \text{ J/g}^\circ\text{C}$$

Endothermic or exothermic? endo

8. If 335 g of water at  $65.5^\circ\text{C}$  loses 9750 J of heat, what is the final temperature of the water? Liquid water has a specific heat of  $4.18 \text{ J/(g}^\circ\text{C)}$ .

$$T_f = 58.54^\circ\text{C}$$

Endothermic or exothermic? exo